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There was a letter in Feedback, September 1999 issue of Rotor & Wing entitled "Go-No-Go" from James D. Thomas, Jr. of Charleston, WV. The following description addresses my involvement with a Tail Rotor Flapping problem with the SH-3 Helicopter, now long since solved.

Early on the SH-3A helicopters had a problem, now corrected, called "Tail Rotor Buzz". Occasionally there would be a vibration which the pilots could feel in the pedals and hear (hence the buzz). In most cases it would go away, but occasionally there would be a "Bang" and the tail rotor would shed three blade pockets behind the leading edge spar, leaving the tail rotor at 2/5 capacity. The aircraft would spin to the right and crash.

Investigations over the years indicated that a right front quartering wind of 15 to 25 Kt (well within the envelope) was where this problem was encountered. Initial indications were that the root end of the blade was hitting the flap-stop (going inboard) and bending. Sikorsky asserted that it was impossible at 100 % rpm for the blade to contact the flapping stop. And so it was, based on the normal 2 dimensional airfoil section data. Wind Tunnel test results, as I remember, at University of Cambridge, England, from an oscillating airfoil showed that in "Dynamic Stall" (See Prouty's "Maximum Thrust", August 1999 Rotor and Wing) rotor section lift coefficients (CL) could be substantially higher than the static CL maximum. Although Prouty does not mention the words "Dynamic Stall", it is identical to his Figure 3 (Lift Overshoot due to Rapid Change of Angle of Attack) and can go from a 1.1 maximum statically, to a maximum of about 3.0 dynamically, or almost three times the maximum lift coefficient that the designers contemplated in the original design. Sikorsky decided that could run the blades into the stop.

The aerodynamic mechanism was due to the intermittent blockage from the pylon, which created an oscillating pitch angle change as the blade went around the circle at these "threat conditions". The failure mechanism was to drive the blade inboard until it hit the stop and then the root section would bend inboard changing the "delta three" relationship (ratio of flapping to feathering) and the blade would shed its pocket. Immediately thereafter, the two opposite blades would shed their pockets also, leaving only two blades intact on the 5 bladed tail rotor.

Sikorsky made three modifications to the aircraft (plus anotherone that I will get to in a moment) to solve this problem on its commercial aircraft as follows: 1. Stiffen the TR drive shaft. 2. Stiffen the "Spider Arm". 3. Install a mechanical stop in the pedals. The Navy for its Fleet bought only the first two items, not wanting to give up the blade angle throw and limiting control. Years later I discovered, quite by accident, the fourth modification made to the VH-3A aircraft. It included a pair of stiffener blocks bolted to each blade on either side at the root section so that if the blade did hit the stop the root section would not bend. The problem went away in the SH-3 aircraft so that "Tail Rotor Buzz" is now only of historical interest for this aircraft, but understanding the problem may be of use in other tail rotor designs.

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